A COMPARATIVE STUDY OF THE FOODS OF THE SORA AND VIRGINIA RAIL[1]

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Three species of rails nest regularly in the marshes of northern Iowa: Sora (*Porzana carolina*), Virginia Rail (*Rallus limicola*), and King Rails (*Rallus elegans*). The former two are quite abundant in most years and usually frequent the same habitat. To compare their possible competition for foods, a study was conducted during the summers of 1963 and 1964. Emphasis was placed on comparing food availability with its utilization by the two species of rails. Attempts to correlate food habits with food availability have been reported by Glading, Biswell, and Smith (1940) in their study of California Quail, by Bellrose and Anderson (1940) on ducks, and by Hungerford (1957) on Ruffed Grouse. The present study attempts to show this relationship for the Sora and Virginia Rail.

STUDY AREA

Rails were collected from three areas in Iowa: Jemmerson Slough in Dickson County (Section 31, Spirit Lake Township); Goose Lake in Hamilton County (Section 27, Lyon Township); and Smith's Slough in Clay County (Section 26, Lake Township). Most of the work was conducted on Smith's Slough, a 287 acre marsh bounded by Trumbull Lake on the west, cultivated land on the north and south, and by county road H on the east. Water leaves this study area from the southwestern section by way of two narrow channels which lead into Trumbull Lake. The marsh is never more than 4 feet deep and most is less than 2 feet in depth.

The dominant vegetation of the upland area surrounding Smith's slough is Kentucky blue grass (*Poa pratensis*). The wet-meadow and shallow marsh areas consist mainly of slough grass (*Spartina pectinata*), sedge (*Carex* spp.), and smartweed (*Polygonum* sp.) The major plants of the deep-marsh zone are narrow-leaved cattail (*Typha angustifolia*) and river bulrush (*Scirpus fluviatilis*). Approximately 25 percent of the deep water part of the marsh was open water during the study.

METHODS

Analysis of food habits.—Rails were collected either by shooting or by driving them into traps. The gizzard and proventriculus were removed as soon as possible and preserved. The preserved organs were cut open and the contents were washed into a sieve constructed of three strainers: a 1/16-inch wire mesh, a 1/32-inch wire mesh, and a linen cloth to catch the finer particles. If the gizzard contained grit, the sample was placed into a 250 ml beaker and carbon tetrachloride was added. After a few minutes, the grit sank to the bottom and the food material floated. The food and grit were placed in individual Petri dishes and allowed to dry for several hours.

The contents of the organs were then examined with a dissecting microscope. The sample was separated into major groups and an estimate was made of the numbers

[1] Contribution from Federal Aid to Wildlife Restoration Investigations Project, Iowa, PR-W-105-R, and Iowa State University, Department of Zoology and Entomology.

of each type of food. Seeds were identified with the aid of Martin and Barkley (1961), and Isely and Braggonier (1962); and invertebrates with the aid of Eddy and Hodson (1958), Pennak (1953), and Usinger (1956). After all the gizzards were examined, the process was repeated and the contents were rechecked without reference to oirginal identifications. This time the sample was measured on a volumetric basis along with the enumeration. Each major group of foods was dried and placed in a graduated centrifuge tube which measured to the nearest $\frac{1}{10}$ ml. Particles smaller than $\frac{1}{10}$ ml were designated as a trace.

McAtee (1912) strongly recommended the use of the volumetric method for analyzing food habits. He stated that frequency of occurrence and enumeration gave no indication of the size of food particles and, in most cases, overemphasized foods which were very resistant to digestion. The frequency of occurrence method is the quickest while enumeration is the most time consuming when small food items are present. During this study, all three major methods of analyzing gizzard contents were used to assure maximum accuracy.

Measuring Food Availability.—Because rails feed mostly in shallow water areas, an attempt was made to measure both the flora and fauna of this habitat. A cylindrical bottom sampler with a diameter of 29 inches and height of 20 inches was made of sheet metal and covered an area of $\frac{1}{4000}$ of an acre. The sampler was placed randomly in an area known to be used regularly by rails. The lower edge of the cylinder was forced into the muck to prevent organisms from escaping and water from seeping in; then the muck and water were removed. This sample was then poured through a "tube separator" made out of three sections of stove pipe. Each section contained a screen with a different sized mesh: $\frac{1}{2}$ inch at the top, $\frac{1}{4}$ inch in the middle, and $\frac{1}{16}$ inch at the bottom. These mesh sizes were chosen because they strained out the potential foods but still allowed water and muck to flow through the tube.

FOOD UTILIZATION

Nineteen Soras and thirty-seven Virginia Rails were collected for study. Two Soras and two Virginia Rails were trapped in Jemmerson's Slough and one Virginia and three Soras were from Goose Lake. The remaining birds were caught in Smith's Slough. The rails were taken, for the most part, in shallow water of less than 24 inches deep in areas of dense stands of cattail or sedge.

Table 1 shows, for each type of food found, the comparison in per cent, frequency of occurrence, enumeration, and volume. The findings show that seeds occur more often in the food of the Sora than in that of the Virginia Rail, while animal foods occur more often in the food of the Virginia Rail. However, Virginia Rails consumed a much larger amount of duckweed (*Lemna* spp.).

Grit was not included with the foods shown in Table 1 because the differences in the amounts consumed by the two species would bias the volumetric measurements. Therefore, grit was computed as a percentage of the total gizzard contents by the volumetric method. Soras contained an average of 23.2 per cent grit while Virginia Rails contained an average of

TABLE 1
FOOD HABITS OF (19) SORA AND (37) VIRGINIA RAILS
COMPARING THREE DIFFERENT MEASUREMENT INDICES.

Foods consumed	Frequency of occurrence (per cent)		Enumeration (per cent)		Volume (per cent)	
	Sora	Virginia	Sora	Virginia	Sora	Virginia
Adult insects						
Coleoptera	31.5	35.1	0.4	3.7	T	2.4
Calliphoridae	5.2	0	T*	0	0.5	0
Gryllidae	5.2	0	T	0	1.7	0
Hydrophilidae	15.6	40.5	0.2	3.7	0.5	13.7
Curculionidae	5.2	2.7	T	3.7	T	T
Dytiscidae	10.5	37.8	0.2	3.4	T	4.6
Diptera	0	2.7	0	0.2	0	0.2
Odonata	5.2	5.4	T	0.6	8.7	12.1
Notonectidae	0	2.7	0	0.2	0	T
Nitidulidae	5.2	0	T	0	T	0
Unknown	10.5	10.8	—	—	2.4	2.0
Insect larvae						
Hydrophilidae	15.6	32.8	0.2	5.3	T	2.0
Dytiscidae	0	16.2	0	1.5	0	T
Diptera	21.0	43.2	0.3	15.9	T	22.0
Unknown	5.2	10.8	—	—	0.8	1.5
Crayfish						
Decapoda	0	5.4	0	0.3	0	9.1
Unknown animal	15.6	40.5	—	—		9.0
Snail						
Helisoma	10.5	18.9	0.2	3.0	1.2	3.9
Physa	5.2	0	0.7	0.3	T	T
Unknown	42.1	35.1	—	—	1.3	2.1
Vegetation						
Polygonum	52.6	24.3	36.4	3.7	18.0	T
Carex	79.0	35.1	27.8	9.2	21.5	1.7
Setaria	10.5	0	17.2	0	20.0	T
Lemna	31.5	37.8	11.2	44.7	7.9	12.8
Scirpus	5.2	5.4	3.9	T	0.5	T
Agropyron	0	10.8	0	1.1	0	T
Unknown seeds	42.1	8.1	—	—	12.9	0.9

* T = less than .1 per cent.

2.6 per cent grit. The high incidence of grit is characteristic of most seed-eating birds (Berger, 1961).

All three of the techniques of measurements and analysis indicated that there was a definite overlap in the kinds of food eaten by the two species of

TABLE 2

PER CENT ENUMERATION OF POTENTIAL FOODS FOUND IN 21 BOTTOM SAMPLES.

Potential foods	Enumeration (per cent)	Potential foods	Enumeration (per cent)
Vegetation (seeds)		Snails	
Polygonum	24.5	*Helisoma*	1.1
Carex	11.5	*Stagnicola*	2.9
Scirpus	3.0	*Physa*	2.6
Potamogeton	0.3	*Gyraulus*	1.5
Typha	T*	*Planorbula*	2.9
Unknown	3.0	*Fossoria*	T
Insect adults		Leeches	
Diptera	1.1	*Erpobdella*	2.6
Hydrophilidae	2.2	*Helobdella*	0.6
Hemiptera	T	Misc. invert.	
Dytiscidae	1.1	*Hyalella*	20.6
Coleoptera	1.0	*Camborus*	0.6
		Isoptera	T
Insect larvae			
Diptera	12.2		
Hydrophilidae	T		
Hemiptera	T		
Coleoptera	1.5		

* T = less than .1 per cent.

rails, but Soras clearly ate a larger amount of plant material than did Virginia Rails. Pospichal and Marshall (1954) found that there was considerable overlap of foods between the two species of rails. Martin, Zim, and Nelson (1951) stated that during the summer the Virginia Rails ate about 3 per cent plant material, while Soras ate 40 per cent plant material. None of these investigators related foods eaten to food available.

FOOD AVAILABILITY IN RELATION TO USE

A total of twenty-one bottom samples was taken with the cylindrical sampler. The locations of the samples were chosen randomly near the trap sites. After a sample was taken and the muck and debris were removed, each potential food item was classified into taxonomic groups and enumerated (Table 2). Weights also were measured, but on a much broader classification than enumeration: for example, seeds, insects, snails, leeches and miscellaneous invertebrates. Table 3 compares percentage composition according to weights and enumeration.

An index rating, based upon Bellrose and Anderson's (1940) method, was used to relate the food-habits of the Sora and Virginia Rails to food availability. Bellrose and Anderson (1940) designated the food habits as

Table 3
Comparison of Per cent Weight and Enumeration of Potential Foods found in 21 Bottom Samples.

Potential foods	Weight (per cent)	Enumeration (per cent)
Seeds	20.7	42.3
Insects	35.5	20.1
Snails	26.1	11.0
Leeches	13.4	3.2
Misc. Invert.	4.1	21.6

the percentage of foods utilized by the birds, and this was measured by the volumetric method. Food availability or percentage of abundance was based upon acres of various vegetative communities. In the present study, the percentage of foods used by the rails was based on the enumeration of the bottom samples. It was assumed that all foods present were equally available to feeding birds.

Table 4 presents the data on bottom sample contents, per cent used, per cent abundance and utilization index rating of the Sora and Virginia Rails. A rating of 1.0 indicates that the food material was used approximately in proportion to its abundance. A rating of more than 1.0 indicates that the food was preferred by rails and a rating of less than 1.0 would indicate that food was less utilized than its abundance would imply. The index rating showed that the Soras preferred three seed types: *Polygonum*, *Carex*, *Scirpus*, and one insect, hydrophilid larva. The index rating also showed that the Virginia Rails preferred no seeds but selected six insect types: Diptera larva, adult and larval Hydrophilidae, adult Coleoptera, adult dytiscids, Hemiptera adult and one snail, *Helisoma*.

Table 4 indicated that 28.4 per cent of Sora foods and 46.6 per cent of the foods of the Virginia Rail were not found in the bottom samples. However, of these foods, *Lemna* was found 11.2 per cent of the time by enumeration in the Sora and 44.7 per cent in the Virginia Rail. An exact count of each individual duckweed plant was not recorded in the bottom samples, and thus, a utilization index could not be calculated. However, the per cent of surface area covered in each bottom sample by the species was approximated and it was found that all the samples contained from 50 to 100 per cent *Lemna*.

Of the 28.4 per cent of Sora foods not recorded in bottom sample, 17.2 per cent of this was foxtail. Foxtail appeared in only two of the rails. The foxtail group is predominantly a wet-meadow plant, a fact which would account for its not being collected in the bottom samples and also would indicate that the Sora may venture out of the marsh to feed. During the night

TABLE 4

INDEX TO FOOD UTILIZATION BY SORA AND VIRGINIA RAILS, 1963 AND 1964.

Organism found in bottom sample	Per cent used (enumeration)		Per cent abundance (enumeration)	Index rating	
	Sora	Virginia		Sora	Virginia
Seeds					
Polygonum	36.4	3.7	24.5	1.6	0.1
Carex	27.8	9.2	11.5	2.4	0.8
Scirpus	3.9	0.0	3.0	1.3	0.0
Potamogeton	0.0	0.0	0.3	0.0	0.0
Typha	0.0	0.0	0.1	0.0	0.0
Najas	0.0	0.0	0.1	0.0	0.0
Insects					
Diptera larva	0.3	15.9	12.2	0.2	1.3
Diptera adult	0.0	0.2	1.1	0.0	0.2
Hydrophilidae adult	0.2	3.7	2.2	0.1	1.7
Hydrophilidae larva	0.2	5.3	0.2	1.0	2.6
Hemiptera adult	0.0	0.2	0.2	0.0	1.0
Hemiptera larva	0.0	0.0	1.3	0.0	0.0
Coleoptera adult	0.4	3.7	2.0	0.2	1.8
Dytiscidae adult	0.2	3.5	1.1	0.2	1.7
Snails					
Helisoma	0.2	3.0	1.1	0.2	2.7
Stagnicola	0.0	0.0	2.9	0.0	0.0
Physa	0.6	0.3	2.6	0.2	0.1
Gyraulis	0.0	0.0	1.5	0.0	0.0
Planorbula	0.0	0.0	2.9	0.0	0.0
Leeches					
Erpobdella	0.0	0.0	2.7	0.0	0.0
Helobdella	0.0	0.0	0.6	0.0	0.0
Misc. Invert.					
Hyalolla	0.0	0.0	20.6	0.0	0.0
Camborus	0.0	0.0	0.6	0.0	0.0
Isoptera	0.0	0.0	0.1	0.0	0.0
Foods not found in bottom sample					
Agropyron	0.0	1.1			
Setaria	17.2	0.0			
Notonectidae	0.0	0.2			
Odonata	0.0	0.6			
Lemna	11.2	44.7			

of 15 August 1963, a Sora was seen in a cultivated field approximately three miles from any marsh habitat.

In the Virginia Rails, 1.1 per cent of the total food not recorded in the bottom sample was quackgrass, another wet-meadow plant, which also indi-

cates that Virginia Rails may feed in the uplands. The remaining 4.8 per cent of the Virginia Rails food not recorded in the bottom sample consisted of insects.

DISCUSSION

Gause's (1943) principle states that two species with identical ecological requirements cannot live in the same niche. If two species of birds live in the same habitat in the same region, eat the same types of food, and have the same ecological requirements, there will be direct competition between the two species, and one may be eliminated. Grinnell (1904) said that two species can live together only by adaptation to different sorts of foods or modes of food getting. Lack (1944), in his survey of the ecology of passerine birds of Galapágos Islands, showed that similar species occurring together in the same habitat tended to differ from each other in feeding habits and associated morphology of the beak.

The two species of rails observed in this study had some similarities but also major differences in their diets. The Sora, having a heavy short beak, eats approximately 73 per cent seeds, volumetrically. The Virginia Rail, with its long slender decurved beak, eats nearly 62 per cent insects, volumetrically. These differences in food habits between the two species of rails suggest that the two species can live together successfully without serious competition for food.

ACKNOWLEDGMENTS

I extend my appreciation to Milton W. Weller, Leigh H. Fredrickson, David Strohmeyer, and Gerald Kaufmann for their assistance during the project. Milton W. Weller made helpful suggestions on the manuscript.

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